# A Guide to the Geology of the Salem Area

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STATE GEOLOGICAL SURVEY DIVISION
Champaign, Illinois 61820

# GUIDE TO THE ROUTE



| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.0 | 0.0 | Line up heading west on East Seneff Street. Mileage figures begin at the intersection with North Main Street at the southwest corner of Salem Community High School. TURN LEFT (south) on North Main Street and State Route (SR) 37. |
| 0.1- | 0.1- | To the left is the monument to William Jennings Bryan. |
| 0.45+ | 0.55+ | CAUTION: Enter Salem Business District. CONTINUE AHEAD (south). |
| 0.1 | 0.65+ | CAUTION: stoplight with U.S. 50. CONTINUE AHEAD STRAIGHT (south) on Broadway (SR 37). |
| 0.15 | 0.8+ | William Jennings Bryan's home on the left. CONTINUE AHEAD (south). |
| 0.15+ | 0.95+ | CAUTION: Chessie System railroad crossing (CSX) (2 tracks). CONTINUE AHEAD (south). |
| 0.15+ | 1.15- | CAUTION: Missouri-Illinois (MI) railroad crossing (1 track)—abandoned. CONTINUE AHEAD (south). |
| 0.05+ | 1.2 | From here on south in Salem, on both sides of the highway, are a number of firms that have oil-field equipment (tanks, pumps, and drilling supplies) for sale. CONTINUE AHEAD (south). |
| 0.55+ | 1.75+ | Prepare to turn right just ahead, part way through the left curve. |
| 0.1- | 1.85+ | BEAR RIGHT (south) on South Washington, a blacktop street. |
| 0.3 | 2.15- | STOP (1-way); T-intersection—South Washington with West Kell. TURN RIGHT (west). |
| 1.3 | 3.45- | Cross over I-57. CONTINUE AHEAD (west). |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.45- | 3.9- | STOP (2-way); T-intersection (900N, 900E). TURN LEFT (south) on blacktop. |
| 0.6- | 4.45+ | CAUTION: T-intersection (850N, 875E). BEAR LEFT (south) on 875E. |
| 1.0 | 5.45+ | CAUTION: T-intersection with one-way stop (750N, 875E). TURN LEFT (east). |
| 0.55 | 6.0 | Cross Crooked Creek. |
| 0.5 | 6.5 | STOP 1 just north of the culvert. CAUTION in parking. To the right of the road (west) are some old coal drift mines, probably from the middle 1800s. |
| 0.0 | 6.5 | Leave Stop 1 and CONTINUE AHEAD (south). |
| 0.15+ | 6.65+ | STOP (1-way); T-intersection (650N, 900E). TURN RIGHT (west). |
| 0.85- | 7.5 | To the right are several pump jacks in the Salem Oil Field. |
| 0.3 | 7.8 | CAUTION: cross culvert; road is very rough ahead. |
| 0.2- | 8.0- | STOP (1-way). CAUTION: visibility from the right is poor because of the curve; traffic is fairly fast. CONTINUE AHEAD (west and then south) on the blacktop. |
| 0.8+ | 8.8 | Cross Martin Branch which drains Lake Centralia just to the left (east). At the west end of the concrete spillway on the north side of Martin Branch is one of the best exposures of Illinoian till in the area, about 18 to 20 feet thick. CONTINUE AHEAD (southerly) on the blacktop, BEAR RIGHT and ascend hill. |
| 0.5 | 9.3 | Prepare to turn right beyond the tank battery that is on the right (north) side of the road. |
| 0.1+ | 9.4+ | TURN RIGHT (north) just beyond the large pump jack onto a private Texaco Company road. USE EXTREME CAUTION IN THIS AREA. This is STOP 2. |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.1- | 9.5+ | To the right notice modern pump jack operating beneath the tall steel derrick. The latter is a hold-over from the early days of drilling in the late 1930s here. |
| 0.1- | 9.6- | T-road from the left. BEAR RIGHT and then CURVE LEFT (north). |
| 0.15+ | 9.75+ | On the right is a concrete monument for the discovery well of the Salem Oil Field, the Texas Company #1 Tate. STOP 2. |
| 0.0 | 9.75+ | Leave Stop 2 and CONTINUE AHEAD (north). |
| 0.15- | 9.9 | CAUTION: descend hill that is pretty rough in the middle. |
| 0.05+ | 9.95+ | Y-intersection at the bottom of the hill. BEAR LEFT (northerly). |
| 0.05+ | 10.05- | Y-intersection. BEAR LEFT (northwesterly). |
| 0.25- | 10.25+ | T-intersection. TURN RIGHT (north). |
| 0.15- | 10.4 | Cross Crooked Creek. |
| 0.4+ | 10.8+ | Ascend north valley wall. |
| 0.25 | 11.05+ | TURN RIGHT. CAUTION: there's a steel pipe under the blacktop. If you cut the corner too sharp, you are going to drop into a hole. |
| 0.2+ | 11.3- | CAUTION: another right turn with a similar steel pipe and hole. |
| 0.25 | 11.55- | CAUTION: road intersection (725N, 700E)—no stop signs. TURN RIGHT (east) on Texaco private road. Note the 5 old steel derricks on this property. |
| 0.3+ | 11.85 | STOP 3. North Tank Battery: Salem Unit, Texaco, Inc., Operator, Consolidated Battery No. 4. Tract 72, Section 29-2N-2E. |
| 0.0 | 11.85 | Leave Stop 3 and CONTINUE AHEAD (northerly). |
| 0.2+ | 12.05+ | T-road intersection; TURN LEFT (west) on 750N. |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.3- | 12.35- | STOP (1-way); T-intersection (750N, 700E). TURN RIGHT (north). |
| 0.9 | 13.25- | CAUTION: unguarded (MI) railroad crossing (1 track). |
| 0.1 | 13.35- | STOP (2-way); crossroad (850N, 700E). TURN RIGHT (east). |
| 0.2+ | 13.55+ | CAUTION: guarded (MI) railroad crossing. CONTINUE AHEAD (east). |
| 0.55- | 14.05+ | CONTINUE AHEAD (east) but look to the right (south) to note approaching traffic that might affect you. |
| 0.05+ | 14.1+ | STOP (1-way). You are entering the blacktop on the far side of the curve from the right. CONTINUE AHEAD (east) with EXTREME CAUTION. |
| 0.15- | 14.25+ | Leave the main blacktop where it curves to the left, and CONTINUE AHEAD (east) past the brick church. The community of Selmaville lies to the left (north). |
| 0.8+ | 15.05+ | STOP (2-way); T-intersection (850N, 875E). TURN LEFT (northerly) on 875E and retrace a portion of the itinerary. CAUTION: ROUGH ROAD for a short distance. |
| 0.2+ | 15.3- | Cross Vermilion Creek. |
| 0.35+ | 15.65+ | CAUTION: T-road from right (900N, 900E). CONTINUE AHEAD (north). |
| 0.5+ | 16.15+ | CAUTION: rough unguarded (MI) railroad crossing. CONTINUE AHEAD (north). |
| 0.6- | 16.75+ | CAUTION: guarded (CSX) railroad crossing. CONTINUE AHEAD (north). |
| 0.2- | 16.95 | STOP (2-way); crossroad. TURN RIGHT (east) on U.S. 50. There shouldn't be too much trouble making a right turn here because it is a divided 4-lane highway; in addition, there is a turn lane for the interstate and a wide emergency strip on the right side. TURN RIGHT toward Salem. |

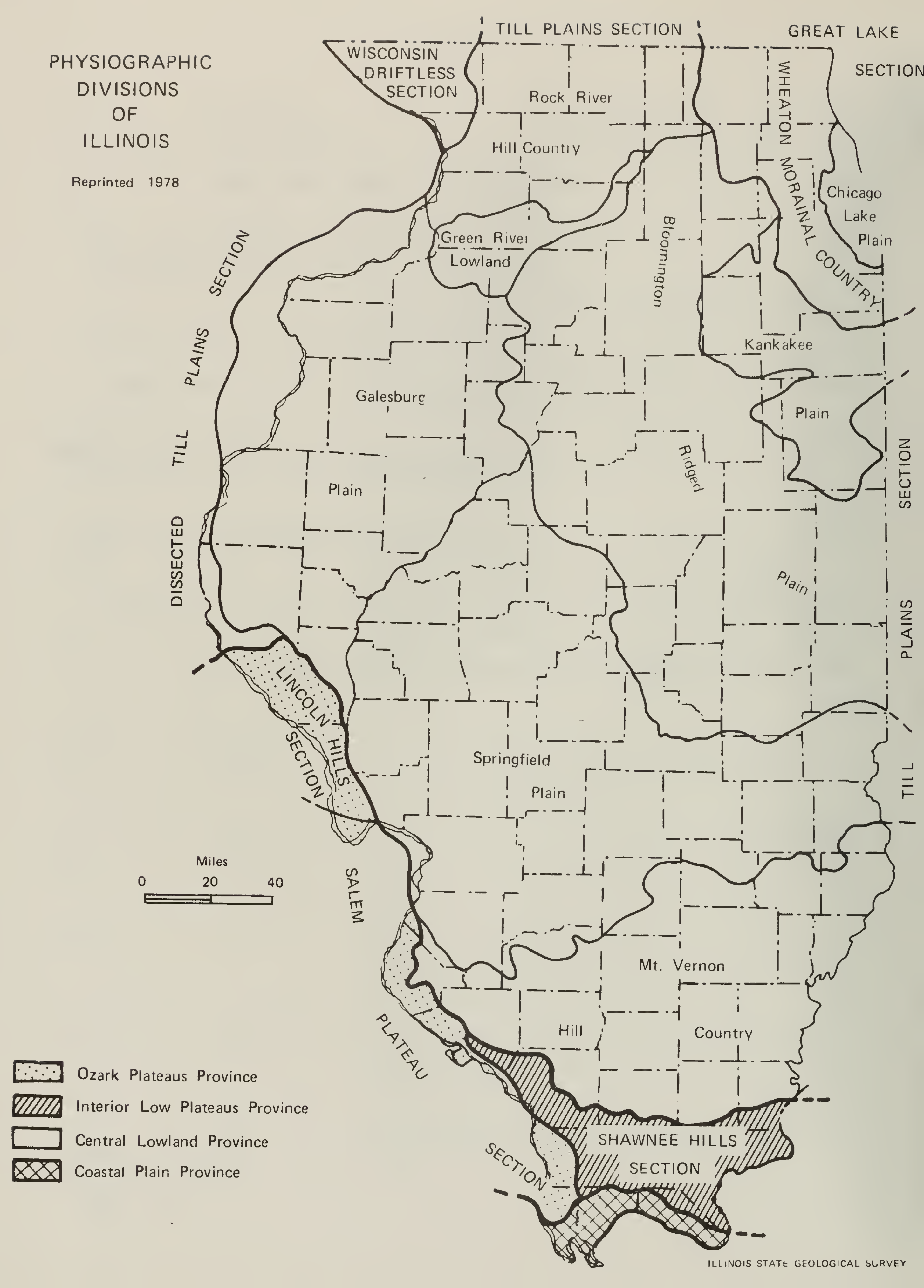
| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.2 | 17.15 | Pass beneath I-57 overpass. |
| 0.4 | 17.55 | CAUTION: TURN RIGHT (south) from West Main Street onto Westgate Avenue (across from MacDonalds). |
| 0.25- | 17.8 | CAUTION: cross guarded (CSX) railroad crossing (1 track). CONTINUE AHEAD (south). |
| 0.1 | 17.9- | STOP (1-way); T-intersection. TURN LEFT (east) onto West Blair. |
| 0.1+ | 18.0- | CAUTION: unguarded (MI) railroad crossing. |
| 0.35+ | 18.35 | The street jogs right slightly and then straightens out eastward. |
| 0.15- | 18.5- | STOP 4—located about 40' east of a fire hydrant on the right (south) side of Blair Street. To the left is the location of the former Salem Coal Company, a shaft mine that operated here about the turn of the 20th century. A small tree marks the shaft site. (The tree is located beyond the row of concrete tiles situated between the large sand pile on the left and the conveyor belt on the right. A red metal building is in the background beyond the CSX railroad tracks.) |
| 0.0 | 18.5- | Leave Stop 4 and CONTINUE AHEAD (east) on West Blair Street. |
| 0.2+ | 18.7+ | STOP (1-way); T-intersection with South College Avenue. TURN LEFT (north) and immediately cross two sets of guarded tracks of the abandoned MI railroad. |
| 0.15- | 18.85+ | CAUTION: guarded (CSX) railroad crossing (3 tracks), with a siding beyond them. CONTINUE AHEAD (north). |
| 0.35- | 19.2- | CAUTION: stoplight. TURN RIGHT(east) on West Main Street (U.S. 50) and enter business district. |
| 0.2 | 19.4- | CAUTION: stoplight at Broadway. CONTINUE AHEAD. |
| 0.1 | 19.5- | CAUTION: stoplight. CONTINUE AHEAD (east). |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.4+ | 19.9+ | CAUTION: guarded two-track railroad crossing, Missouri-Pacific (Mo Pac). CONTINUE AHEAD (east). |
| 3.8- | 23.7 | In this vicinity, notice how generally flat the upland surface appears to be. |
| 0.95- | 24.65- | Cross Dums Creek. |
| 0.5+ | 25.15+ | Cross Dums Creek. |
| 1.4 | 26.55+ | Prepare to turn left. |
| 0.25- | 26.8 | TURN LEFT from 1050N (U.S. 50) onto 1800E. USE EXTREME CAUTION as there is a possibility of fast approaching traffic. |
| 0.95 | 27.75 | CAUTION: descend hill and prepare to stop. |
| 0.1 | 27.85 | CAUTION: cross one-lane bridge over Dums Creek. DO NOT PARK on the bridge. |
| 0.05 | 27.9 | STOP 5. Sandstone overlying silty shale on both sides of the bridge. To the east of the bedrock exposure is a fairly large slump block that has slid into the creek. |
| 0.0 | 27.9 | Leave Stop 5 and CONTINUE AHEAD (north). |
| 0.15+ | 28.05+ | To the left is some crossbedded sandstone that appears to be part of an ancient stream channel that was later filled with sandstone. Just ahead and to the right below the road are a number of large sandstone blocks that indicate the road here is cut through the sandstone exposure and some of the large pieces had to be rolled out of the way. |
| 1.3- | 29.35- | STOP (2-way); crossroad (1300N, 1800E). TURN RIGHT (east). |
| 1.0- | 30.35- | Silty shale is overlain by thick-bedded sandstone along the creek bank and in the roadcut east of the Bee Branch bridge. Some of the sandstone is calcareous and crops out in the valley wall. |
| 0.45+ | 30.8- | STOP (2-way) (1300N, 1950E). TURN LEFT (north) on concrete road. |
| 2.6 | 33.4 | CAUTION: enter the community of Omega. |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.15+ | 33.55+ | STOP (4-way); crossroad (1575N, 1950E). CONTINUE AHEAD STRAIGHT (north). |
| 1.5+ | 35.05+ | CAUTION: T-intersection (1725N, 1950E). TURN RIGHT (easterly) into entrance to Stephen A. Forbes State Fish and Wildlife Area. |
| | | NOTE: Just to the left and parallel to road 1725N is the drive to the Site Superintendent's Office in front of which are two large glacial erratics. Both of these erratics were uncovered when Boston Pond, southeast of the office was constructed in the early days of the park's development. The larger of these igneous rocks is almost 4' in its longest dimension and nearly 3' high. |
| | | BEAR RIGHT at the first T-intersection. |
| 0.3- | 35.35 | Boat Dock and Concession Stand to the left. BEAR RIGHT (easterly). |
| 0.3- | 35.65- | Entrance to Circle Drive Picnic Area on the left. CONTINUE AHEAD (southeasterly). |
| 0.1+ | 35.75+ | The ditch on the right has been eroded down through glacial drift, and this has exposed a large erratic granite boulder that is probably at least 2' across. Below the boulder some thin sandstone beds crop out to form a stair-step waterfall down to the bottom of the draw. CONTINUE AHEAD (southeasterly). |
| 0.8- | 36.55 | TURN LEFT (northeasterly) into the entrance of the Sassafras Picnic Area. |
| | | STOP 6. Lunch. |
| 0.0 | 36.55 | Leave Stop 6. Resume mileage from picnic area entrance. TURN LEFT (southeasterly) upon entering the main park road. |
| 1.1+ | 37.65+ | Lookout Point Picnic Area to the left on the sharp curve. |
| 0.1+ | 37.75+ | CONTINUE AHEAD on the park road and enter the area of the dam. |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.15 | 37.9+ | Cross spillway bridge. Do NOT stop on the bridge. |
| 0.15 | 38.05+ | TURN LEFT into entrance of the Lakeview Picnic Area parking lot and park. |
| | | STOP 7. View and discussion of Pennsylvanian Channel Sandstone that is exposed in the east bank of the channel just below the spillway. |
| | | CAUTION: Traffic may be heavy at times along road. Be careful where standing when studying the 15-18 foot thick channel sandstone. |
| 0.0 | 38.05+ | Leave Stop 7. Resume mileage figure at picnic area entrance. TURN LEFT (northerly) on main park road. |
| 0.2+ | 38.25+ | T-road from right. TURN RIGHT (east). |
| 0.05- | 38.3 | CAUTION: enter county road (1660N, 2150E). TURN LEFT (north). Notice the gently undulating character of the upland surface through here. |
| 3.6 | 41.9- | STOP (2-way); crossroad (2000N, 2175E). TURN RIGHT (east) onto the Kinmundy-Louisville blacktop. |
| 2.25+ | 44.15- | Enter Clay County (00E). |
| 0.7- | 44.8+ | Cross over the Illinois Central Gulf (ICG) Railroad "Edgewood Cutoff." |
| 2.2 | 47.0+ | Prepare to turn left at the Iola-Xenia crossroad. |
| 0.2+ | 47.25 | TURN LEFT (north) from 1100N onto 300E. CAUTION: the road is under construction. |
| 2.05+ | 49.3+ | Bedrock is exposed in the ditch to the left. Grayish-brown shale has a large, dark gray, lenticular, limestone mass about a foot or more thick and possibly 8 to 10 feet across. |
| 1.0- | 50.3 | To the left in the draw is some more of the shale and nodular limestone masses overlain by glacial till. |
| 0.1 | 50.4 | Cross Crooked Creek (<u>not</u> the same one noted in Marion County) bridge and TURN RIGHT (east) on 1410N. |

| Miles to next point | Miles from starting point | |
|---|---|---|
| 0.9 | 51.3 | CAUTION: crossroad (1400N, 400E). TURN LEFT (north). |
| 0.1 | 51.4 | The grassy hills to the right are part of the reclamation carried out on earlier quarrying operations. |
| 0.1 | 51.5 | To the left are pump jacks and tanks from the Iola South Oil Field. |
| 0.6- | 52.1- | CAUTION: T-road from right (1475N); TURN RIGHT (east). |
| 0.35 | 52.45- | CAUTION: cross Baltimore and Ohio (B&O) railroad (1 track) unguarded crossing that appears to be abandoned. |
| 0.05+ | 52.5 | Entrance to the Iola Quarry Office is to the left. You MUST have permission to enter this property. |
| | | STOP 8. Examination of Pennsylvanian Omega Limestone Member. |
| 0.0 | 52.5 | Leave Stop 8. End of field trip. |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TILL PLAINS SECTION
SALEM PLATEAU SECTION
Mt. Vernon
Hill
Country
SHAWNEE HILLS SECTION
Miles
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Interior Low Plateaus Province
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ILLINOIS STATE GEOLOGICAL SURVEY

# PLEISTOCENE GLACIATIONS IN ILLINOIS

## Origin of the Glaciers

During the past million years or so, the period of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Ice sheets formed in sub-arctic regions four different times and spread outward until they covered the northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed during periods when the mean annual temperature was perhaps 4° to 7° C (7° to 13° F) cooler than it is now and winter snows did not completely melt during the summers. Because the cooler periods lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

## Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was probably enough to lower sea level more than 300 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

## Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called drift. Drift that is ice-laid is called till. Water-laid drift is called outwash.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also unstratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders.

Tills may be deposited as end moraines, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as ground moraines, or till plains, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called outwash. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size--the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an esker. Cone-shaped mounds of coarse outwash, called kames, were formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake quickly lost speed and almost immediately dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were moved across the lake bottom by wind-generated

currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an outwash plain. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as valley trains. Valley trains may be both extensive and thick deposits. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

## Loess and Soils

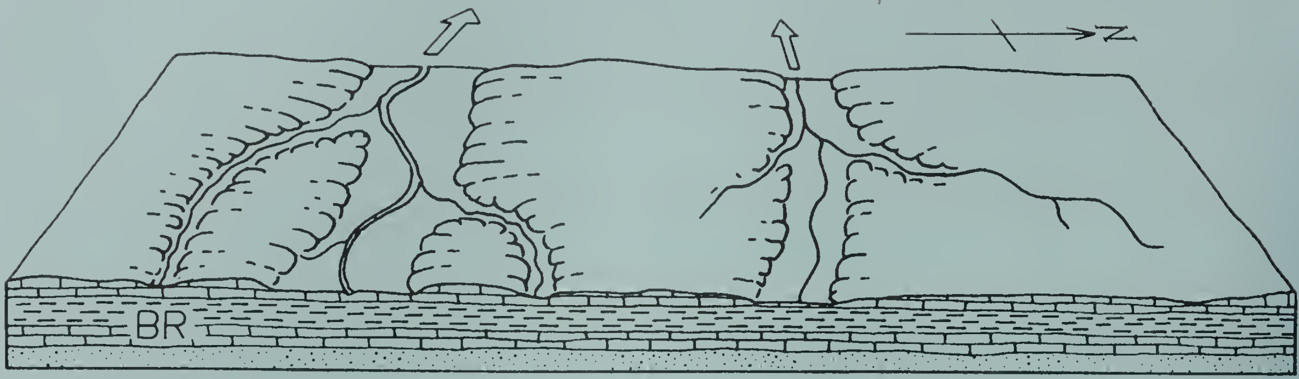
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons when low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but those that survive serve as keys to the identity of the beds and are evidence of the passage of a long interval of time.

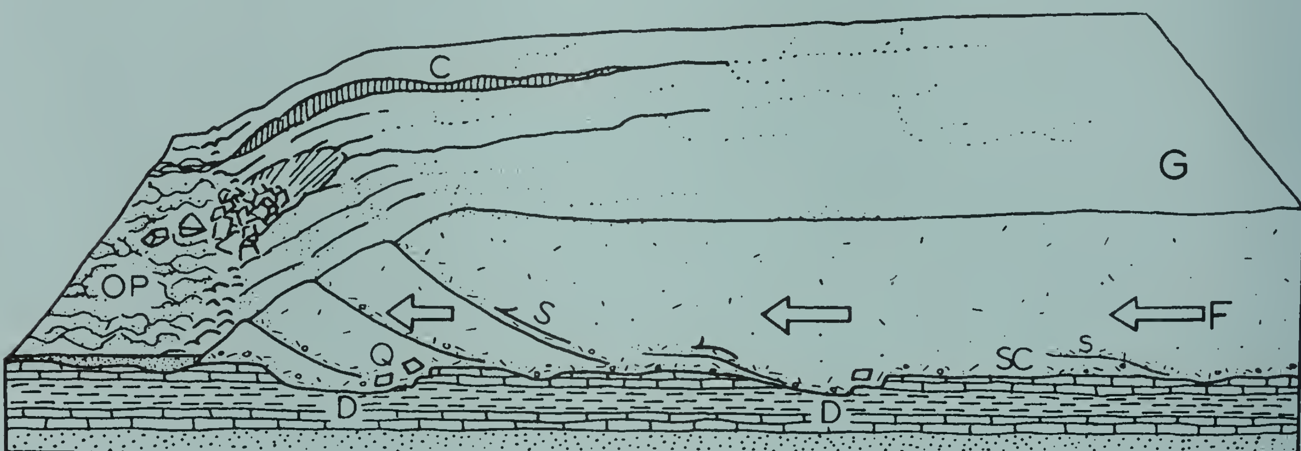
## Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

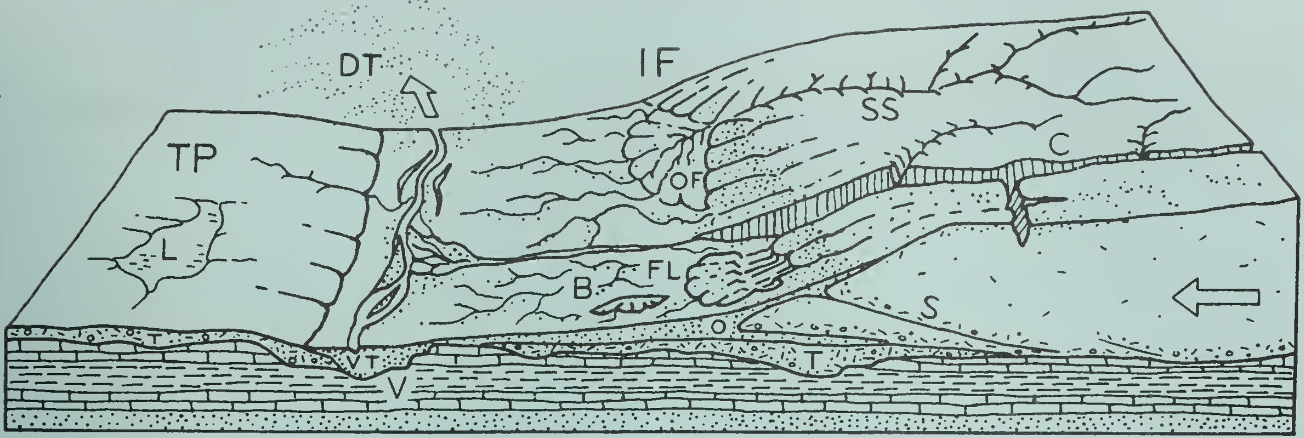
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.




1. The Region Before Glaciation - Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks--layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



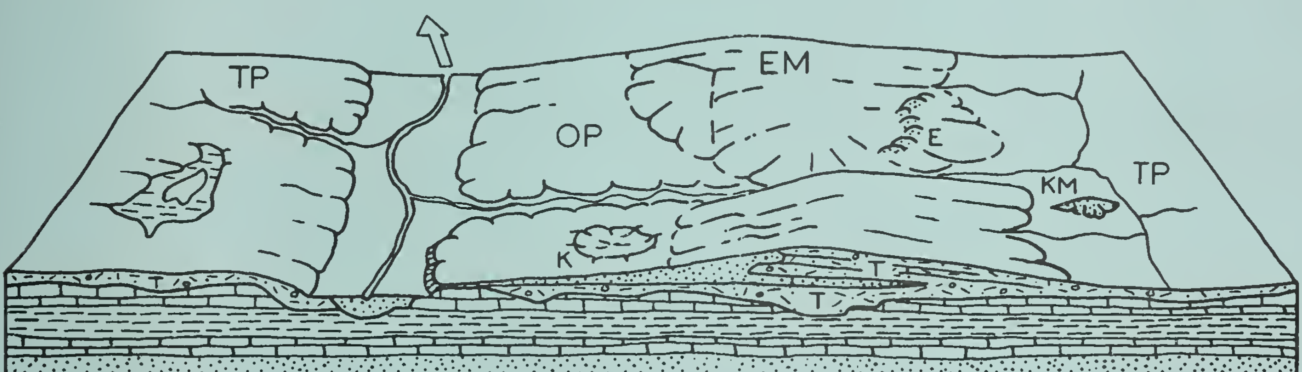

2. The Glacier Advances Southward - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before the ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick , except near its margin. Its ice front advances perhaps as much as a third of a mile per year.




3. The Glacier Deposits an End Moraine - After the glacier advanced across the area, the climate warmed and the ice began to melt as fast as it advanced. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that was mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A superglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) was left as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remained a low spot in the terrain. As soon as its ice cover melted, meltwater drained down the valley, cutting it deeper. Later, outwash partly refilled the valley--the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles.




4. The Region after Glaciation - The climate has warmed even more, the whole ice sheet has melted, and the glaciation has ended. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

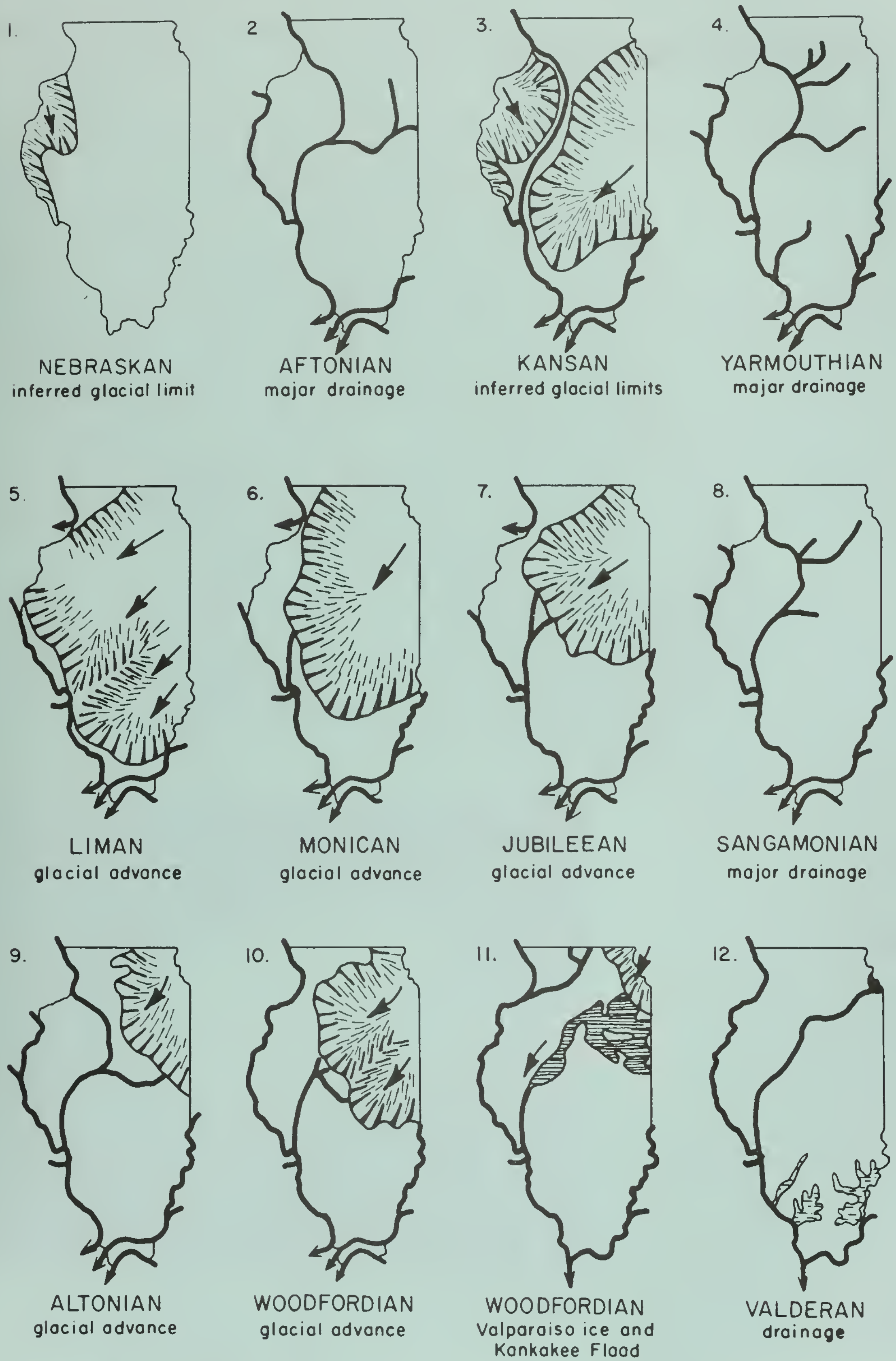
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

TIME TABLE OF PLEISTOCENE GLACIATION

| STAGE | SUBSTAGE | NATURE OF DEPOSITS | SPECIAL FEATURES |
|---|---|---|---|
| HOLOCENE | Years Before Present | Soil, youthful profile of weathering, lake and river deposits, dunes, peat | |
| | 7,000 | | |
| WISCONSINAN (4th glacial) | Valderan | Outwash, lake deposits | Outwash along Mississippi Valley |
| | 11,000 | | |
| | Twocreekan | Peat and alluvium | Ice withdrawal, erosion |
| | 12,500 | | |
| | Woodfordian | Drift, loess, dunes, lake deposits | Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes |
| | 22,000 | | |
| | Farmdalian | Soil, silt, and peat | Ice withdrawal, weathering, and erosion |
| | 28,000 | | |
| | Altonian | Drift, loess | Glaciation in northern Illinois, valley trains along major rivers |
| | 75,000 | | |
| SANGAMONIAN (3rd interglacial) | | Soil, mature profile of weathering | |
| | 175,000 | | |
| ILLINOIAN (3rd glacial) | Jubileean | Drift, loess | Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois |
| | Monican | Drift, loess | |
| | Liman | Drift, loess | |
| | 300,000 | | |
| YARMOUTHIAN (2nd interglacial) | | Soil, mature profile of weathering | |
| | 600,000 | | |
| KANSAN (2nd glacial) | | Drift, loess | Glaciers from northeast and northwest covered much of state |
| | 700,000 | | |
| AFTONIAN (1st interglacial) | | Soil, mature profile of weathering | |
| | 900,000 | | |
| NEBRASKAN (1st glacial) | | Drift | Glaciers from northwest invaded western Illinois |
| | 1,200,000 or more | | |

Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL
DRAINAGE IN ILLINOIS




(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)

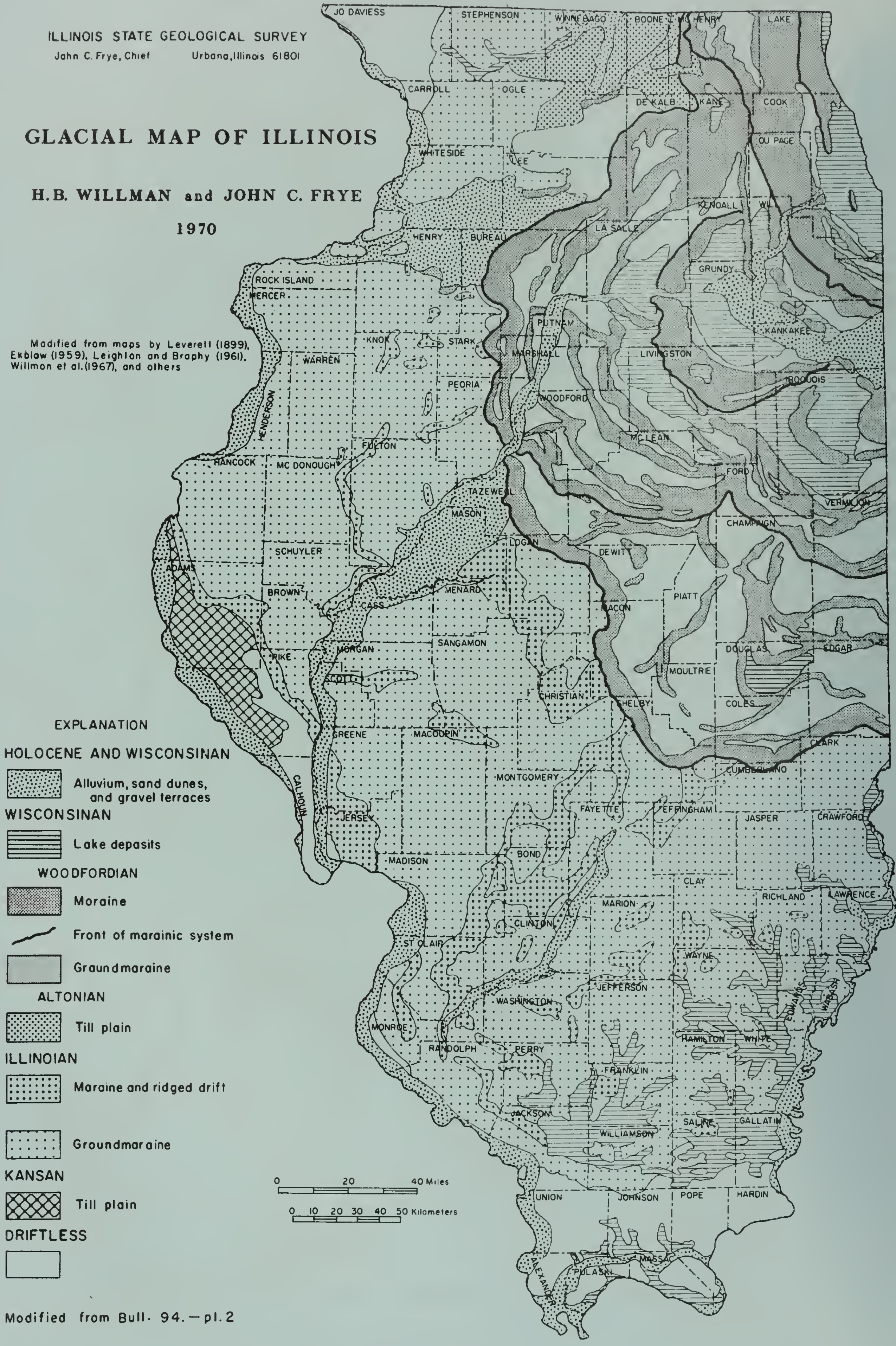
ILLINOIS STATE GEOLOGICAL SURVEY
John C. Frye, Chief    Urbana, Illinois 61801

# GLACIAL MAP OF ILLINOIS

**H.B. WILLMAN and JOHN C. FRYE**

**1970**

Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1961), Willman et al. (1967), and others




Modified from Bull. 94.—pl. 2

ILLINOIS STATE GEOLOGICAL SURVEY
Urbana, Illinois 61801

GEOGRAM 2
October 1974

# ERRATICS ARE ERRATIC

*Myrna M. Killey*

You may have seen them scattered here and there in Illinois—boulders, some large, some small, lying alone or with a few companions in the corner of a field, at the edge of a road, in someone's yard, or perhaps on a courthouse lawn or schoolyard. Many of them seem out of place, like rough, alien monuments in the stoneless, grassy knolls and prairies of our state. Some--the colorful and glittering granites, banded gneisses, and other intricately veined and streaked igneous and metamorphic rocks--are indeed foreign rocks, for they came from Canada and the states north of us. Others—gray and tan sedimentary rocks—are native rocks and may be no more than a few miles from their place of origin. All of these rocks are glacial boulders that were moved to their present sites by massive ice sheets that flowed across our state. If these boulders are unlike the rocks in the quarries and outcrops in the region where they are found, they are called erratics.

The continental glaciers of the Great Ice Age scoured and scraped the land surface as they advanced, pushing up chunks of bedrock and grinding them against each other or along the ground surface as the rock-laden ice sheets pushed southward. Hundreds of miles of such grinding, even on such hard rocks as granite, eventually rounded off the sharp edges of these passengers in the ice until they became the rounded, irregular boulders we see today. Although we do not know the precise manner in which erratics reached their present isolated sites, many were probably dropped directly from the melting front of a glacier. Others may have been rafted to their present resting places by icebergs on ancient lakes or on the floodwaters of some long-vanished stream as it poured from a glacier. Still others, buried in the glacial deposits, could have worked their way up to the land surface as the surrounding loose soil repeatedly froze and thawed. When the freezing ground expands, pieces of rock tend to be pushed upward, where they are more easily reached by the farmer's plow and also more likely to be exposed by erosion.

An eight-foot boulder of pink granite left by a glacier in the bed of a creek about 5 miles southwest of Alexis, Warren County, Illinois. (From ISGS Bulletin 57, 1929.)

Generally speaking, erratics found northeast of a line drawn from Freeport in Stephenson County, southward through Peoria, and then southeastward through Shelbyville to Marshall at the east edge of the state were brought in by the last glacier to enter Illinois. This glaciation, called the Wisconsinan, spread southwestward into Illinois from a center in eastern Canada, reaching our state about 75,000 years ago and (after repeated advances and retreats of the ice margin) melting from the state about 12,500 years ago. Erratics to the west or south of the great arc outlined above were brought in by a much older glacier, the Illinoian, which spread over most of the state about 300,000 to 175,000 years ago. Some erratics were brought in by even older glaciers that came from the northwest.

You may be able to locate some erratics in your neighborhood. Sometimes it is possible to tell where the rock originally came from by determining the kind of rock it is. A large boulder of granite, gneiss, or other igneous or metamorphic rock may have come from the Canadian Shield, a vast area in central and eastern Canada where rocks of Precambrian age (more than 600 million years old) are exposed at the surface. Some erratics containing flecks of copper were probably transported here from the "Copper Range" of the upper peninsula of Michigan. Large pieces of copper have been found in glacial deposits of central and northern Illinois. Light gray to white quartzite boulders with beautiful, rounded pebbles of red jasper came from a very small outcrop area near Bruce Mines, Ontario, Canada. Purplish pieces of quartzite, some of them banded, probably originated in the Baraboo Range of central Wisconsin. Most interesting of all are the few large boulders of Canadian tillite. Tillite is lithified (hardened into rock) glacial till deposited by a Precambrian glacier many millions of years older than the ones that invaded our state a mere few thousand years ago. Glacial till is an unsorted and unlayered mixture of clay, sand, gravel, and boulders that vary widely in size and shape. Tillite is a gray to greenish gray rock containing a mixture of grains of different sizes and scattered pebbles of various types and sizes.

Many erratics are of notable size and beauty, and in parts of Illinois they are commonly used in landscaping. Some are used as monuments in courthouse squares, in parks, or along highways. Many are marked with metal plaques to indicate an interesting historical spot or event. Keep an eye out for erratics. There may be some of these glacial strangers in your neighborhood that would be interesting to know.

# DEPOSITIONAL HISTORY OF THE PENNSYLVANIAN ROCKS

At the close of the Mississippian Period, about 310 million years ago, the Mississippian sea withdrew from the Midcontinent region. A long interval of erosion took place early in Pennsylvanian time and removed hundreds of feet of the pre-Pennsylvanian strata, completely stripping them away and cutting into older rocks over large areas of the Midwest. An ancient river system cut deep channels into the bedrock surface. Erosion was interrupted by the invasion of the Morrowan (early Pennsylvanian) sea.

Depositional conditions in the Illinois Basin during the Pennsylvanian Period were somewhat similar to those that existed during Chesterian (late Mississippian) time. A river system flowed southwestward across a swampy lowland, carrying mud and sand from highlands in the northeast. A great delta was built out into the shallow sea (see paleogeography map on next page). As the lowland stood only a few feet above sea level, only slight changes in relative sea level caused great shifts in the position of the shoreline.

Throughout Pennsylvanian time the Illinois Basin continued to subside while the delta front shifted owing to worldwide sea level changes, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land. These alternations between marine and nonmarine conditions were more frequent than those during pre-Pennsylvanian time, and they produced striking lithologic variations in the Pennsylvanian rocks.

Conditions at various places on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet-water areas—in delta bays between distributaries, in lagoons behind barrier bars, and in deeper water beyond the nearshore zone of sand deposition. Most sediments now recognized as limestones, which are formed from the accumulation of limey parts of plants and animals, were laid down in areas where only minor amounts of sand and mud were being deposited. Therefore, the areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

Nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Some sand bodies, 100 or more feet thick, were deposited in channels that cut through many of the underlying rock units. The shales were deposited mainly on floodplains. Freshwater limestones and some shales were deposited locally in fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps that prevailed for long intervals on the emergent delta lowland. Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not precisely known, but they were probably deposited in the swamps as slackwater muds before the formation of the coals. Many underclays contain plant roots and rootlets that appear to be in their original places. The formation of coal marked the end of the nonmarine portion of the depositional cycle, for resubmergence of the borderlands by the sea interrupted nonmarine deposition, and marine sediments were then laid down over the coal.


Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Pennsylvanian river delta and the position of the shoreline and the sea at an instant of time during the Pennsylvanian Period.

## Pennsylvanian Cyclothems

Because of the extremely varied environmental conditions under which they formed, the Pennsylvanian strata exhibit extraordinary variations in thickness and composition, both laterally and vertically. Individual sedimentary units are often only a few inches thick and rarely exceed 30 feet thick. Sandstones and shales commonly grade laterally into each other, and shales sometimes interfinger and grade into limestones and coals. The underclays, coals, black shales, and

limestones, however, display remarkable lateral continuity for such thin units (usually only a few feet thick). Coal seams have been traced in mines, outcrops, and subsurface drill records over areas comprising several states.

The rapid and frequent changes in depositional environments during Pennsylvanian time produced regular or cyclical alternations of sandstone, shale, limestone, and coal in response to the shifting front of the delta lowland. Each series of alternations, called a cyclothem, consists of several marine and nonmarine rock units that record a complete cycle of marine invasion and retreat. Geologists have determined, after extensive studies of the Pennsylvanian strata in the Midwest, that an ideally complete cyclothem consists of 10 sedimentary units. The chart on the next page shows the arrangement. Approximately 50 cyclothems have been described in the Illinois Basin, but only a few contain all 10 units. Usually one or more are missing because conditions of deposition were more varied than indicated by the ideal cyclothem. However, the order of units in each cyclothem is almost always the same. A typical cyclothem includes a basal sandstone overlain by an underclay, coal, black sheety shale, marine limestone, and gray marine shale. In general, the sandstone-underclay-coal portion (the lower 5 units) of each cyclothem is nonmarine and was deposited on the coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partly marine. The units above the coal are marine sediments and were deposited when the sea advanced over the delta lowland.

## Origin of Coal

It is generally accepted that the Pennsylvanian coals originated by the accumulation of vegetable matter, usually in place, beneath the waters of extensive, shallow, fresh-to-brackish swamps. They represent the last-formed deposits of the nonmarine portions of the cyclothems. The swamps occupied vast areas of the deltaic coastal lowland, which bordered the shallow Pennsylvanian sea. A luxuriant growth of forest plants, many quite different from the plants of today, flourished in the warm Pennsylvanian climate. Today's common deciduous trees were not present, and the flowering plants had not yet evolved. Instead, the jungle-like forests were dominated by giant ancestors of present-day club mosses, horsetails, ferns, conifers, and cycads. The undergrowth also was well developed, consisting of many ferns, fernlike plants, and small club mosses. Most of the plant fossils found in the coals and associated sedimentary rocks show no annual growth rings, suggesting rapid growth rates and lack of seasonal variations in the climate. Many of the Pennsylvanian plants, such as the seed ferns, eventually became extinct.

Plant debris from the rapidly growing swamp forests—leaves, twigs, branches, and logs—accumulated as thick mats of peat on the floors of the swamps. Normally, vegetable matter rapidly decays by oxidation, forming water, nitrogen, and carbon dioxide. However, the cover of swamp water, which was probably stagnant and low in oxygen, prevented the complete oxidation and decay of the peat deposits.

The periodic invasions of the Pennsylvanian sea across the coastal swamps killed the Pennsylvanian forests and initiated marine conditions of deposition. The peat deposits were buried by marine sediments. Following burial, the peat deposits were gradually transformed into coal by slow chemical and physical changes in which pressure (compaction by the enormous weight of overlying sedimentary layers), heat (also due to deep burial), and time were the most important factors. Water and volatile substances (nitrogen, hydrogen, and oxygen) were slowly driven off during the coalification process, and the peat deposits were changed into coal.

Coals have been classified by ranks that are based on the degree of coalification. The commonly recognized coals, in order of increasing rank, are (1) brown coal or lignite, (2) sub-bituminous, (3) bituminous, (4) semibituminous, (5) semianthracite, and (6) anthracite. Each increase in rank is characterized by larger amounts of fixed carbon and smaller amounts of oxygen and other volatiles. Hardness of coal also increases with increasing rank. All Illinois coals are classified as bituminous.

Underclays occur beneath most of the coals in Illinois. Because underclays are generally unstratified (unlayered), are leached to a bleached appearance, and generally contain plant roots, many geologists consider that they represent the ancient soils on which the coal-forming plants grew.

The exact origin of the carbonaceous black shales that occur above many coals is uncertain. The black shales probably are deposits formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was partially closed off from the open sea. In any case, they were deposited in quiet-water areas where very fine, iron-rich muds and finely divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. Most of the fossils represent planktonic (floating) and nektonic (swimming) forms—not benthonic (bottom dwelling) forms. The depauperate (dwarf) fossil forms sometimes found in black shales formerly were thought to have been forms that were stunted by toxic conditions in the sulfide-rich, oxygen-deficient waters of the lagoons. However, study has shown that the "depauperate" fauna consists mostly of normal-size individuals of species that never grew any larger.

10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray but dark gray at top; upper part noncalcareous, lower part calcareous.

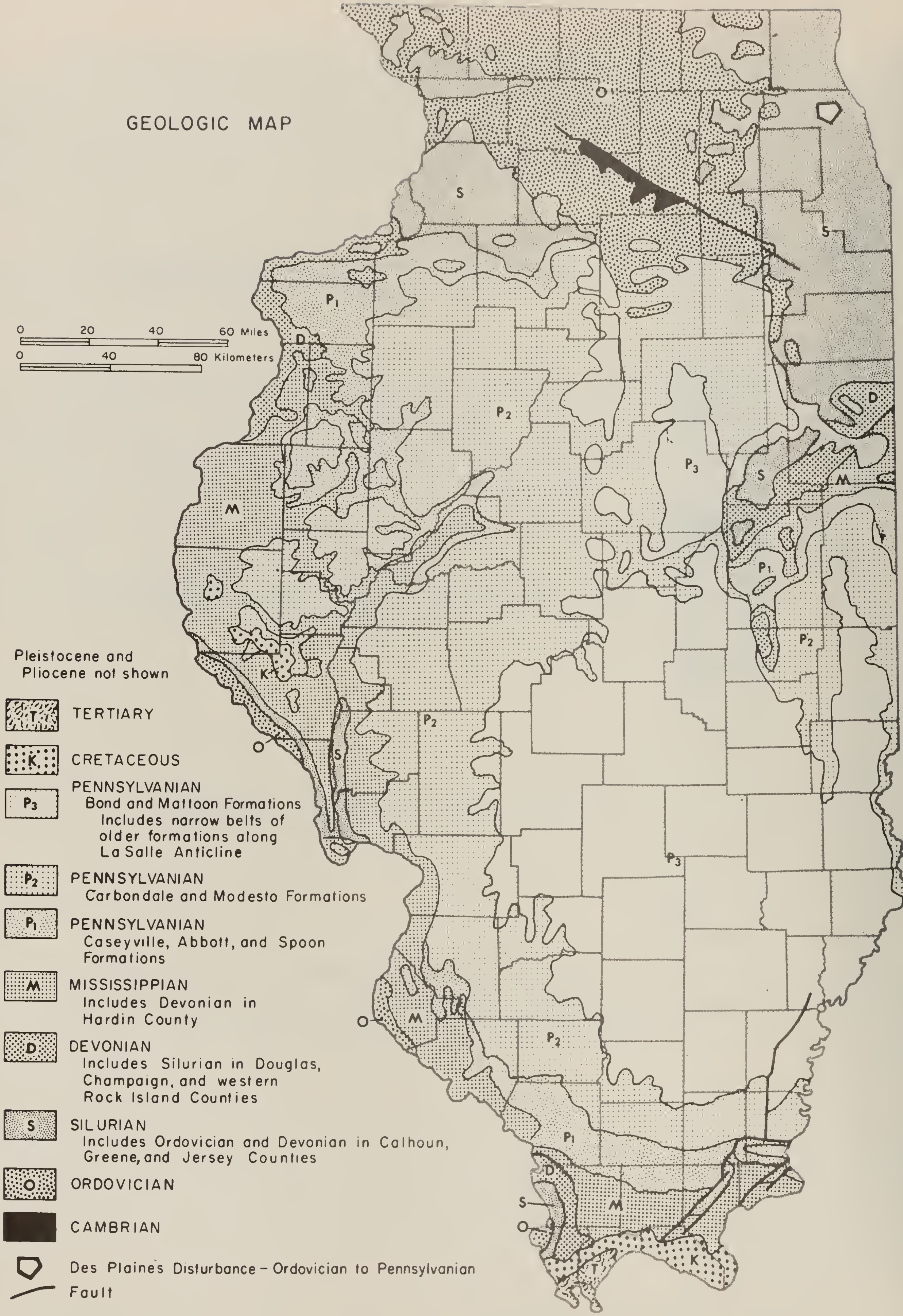
3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

2 Shale, gray, sandy.

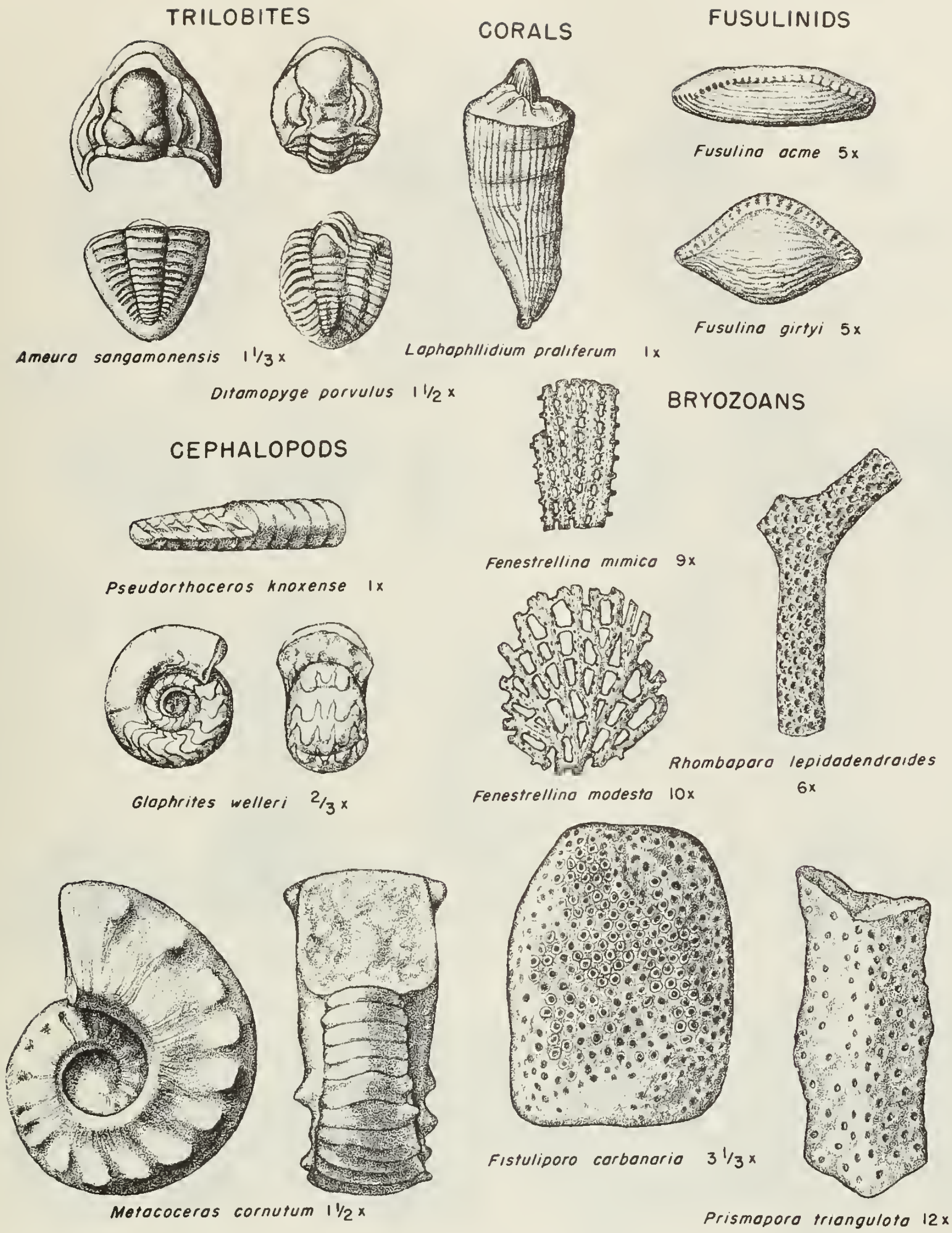
1 Sandstone, fine grained, micaceous, and siltstone, argillaceous; varies from massive to thin bedded; usually has an uneven lower surface.

AN IDEALLY COMPLETE CYCLOTHEM

(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles, by H. B. Willman and J. Norman Payne)

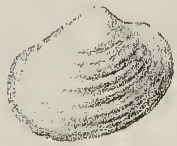


GEOLOGIC MAP
0 20 40 60 Miles
0 40 80 Kilometers
Pleistocene and Pliocene not shown
TERTIARY
CRETACEOUS
PENNSYLVANIAN
Bond and Mattoon Formations
Includes narrow belts of older formations along La Salle Anticline
PENNSYLVANIAN
Carbondale and Modesto Formations
PENNSYLVANIAN
Caseyville, Abbott, and Spoon Formations
MISSISSIPPIAN
Includes Devonian in Hardin County
DEVONIAN
Includes Silurian in Douglas, Champaign, and western Rock Island Counties
SILURIAN
Includes Ordovician and Devonian in Calhoun, Greene, and Jersey Counties
ORDOVICIAN
CAMBRIAN
Des Plaines Disturbance - Ordovician to Pennsylvanian
Fault


TRILOBITES
CORALS
FUSULINIDS
Fusulina acme 5x
Fusulina girtyi 5x
Ameura sangamonensis 1 1/3 x
Lophophyllidium proliferum 1x
Ditomopyge parvulus 1 1/2 x
BRYOZOANS
CEPHALOPODS
Pseudorthoceros knoxense 1x
Fenestrellina mimica 9x
Glaphrites welleri 2/3 x
Fenestrellina modesta 10x
Rhombopora lepidodendroides 6x
Fistulipora carbonaria 3 1/3 x
Metacoceras cornutum 1 1/2 x
Prismopora triangulata 12x

## PELECYPODS

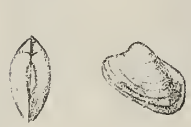
*Nucula (Nuculopsis) girtyi* 1x



*Edmonia ovata* 2x

*Astartella concentrica* 1x

*Dunbarella knighti* 1½x



*Cardiomorpha missouriensis*
"Type A" 1x

*Cardiomorpha missouriensis*
"Type B" 1½x

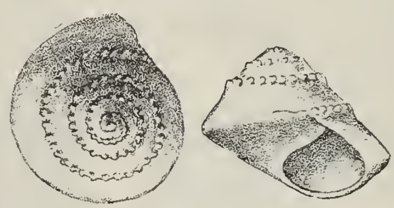
## GASTROPODS

*Euphemites carbonarius* 1½x

*Trepospira illinoisensis* 1½x

*Donaldina robusta* 8x

*Naticopsis (Jedria) ventricosa* 1½x

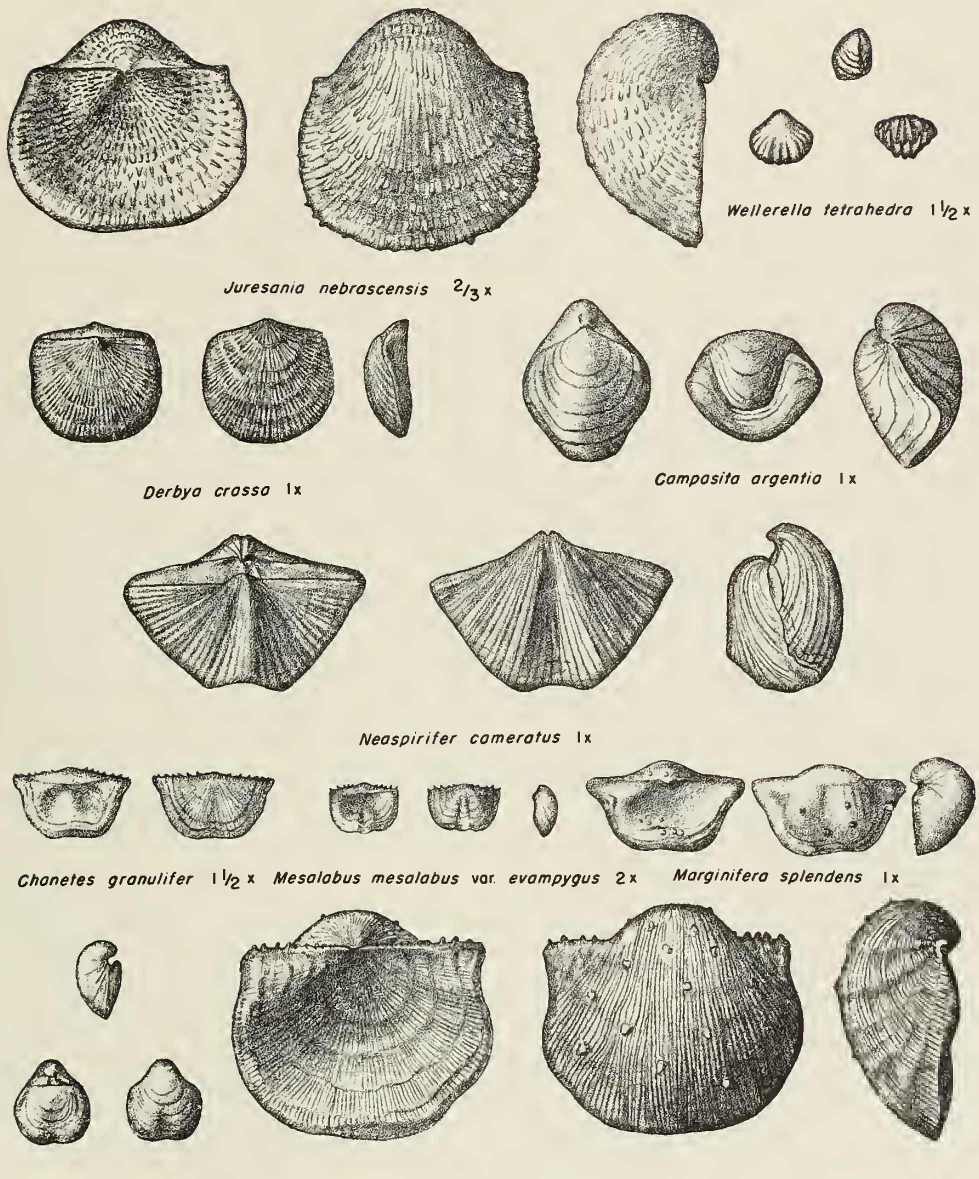


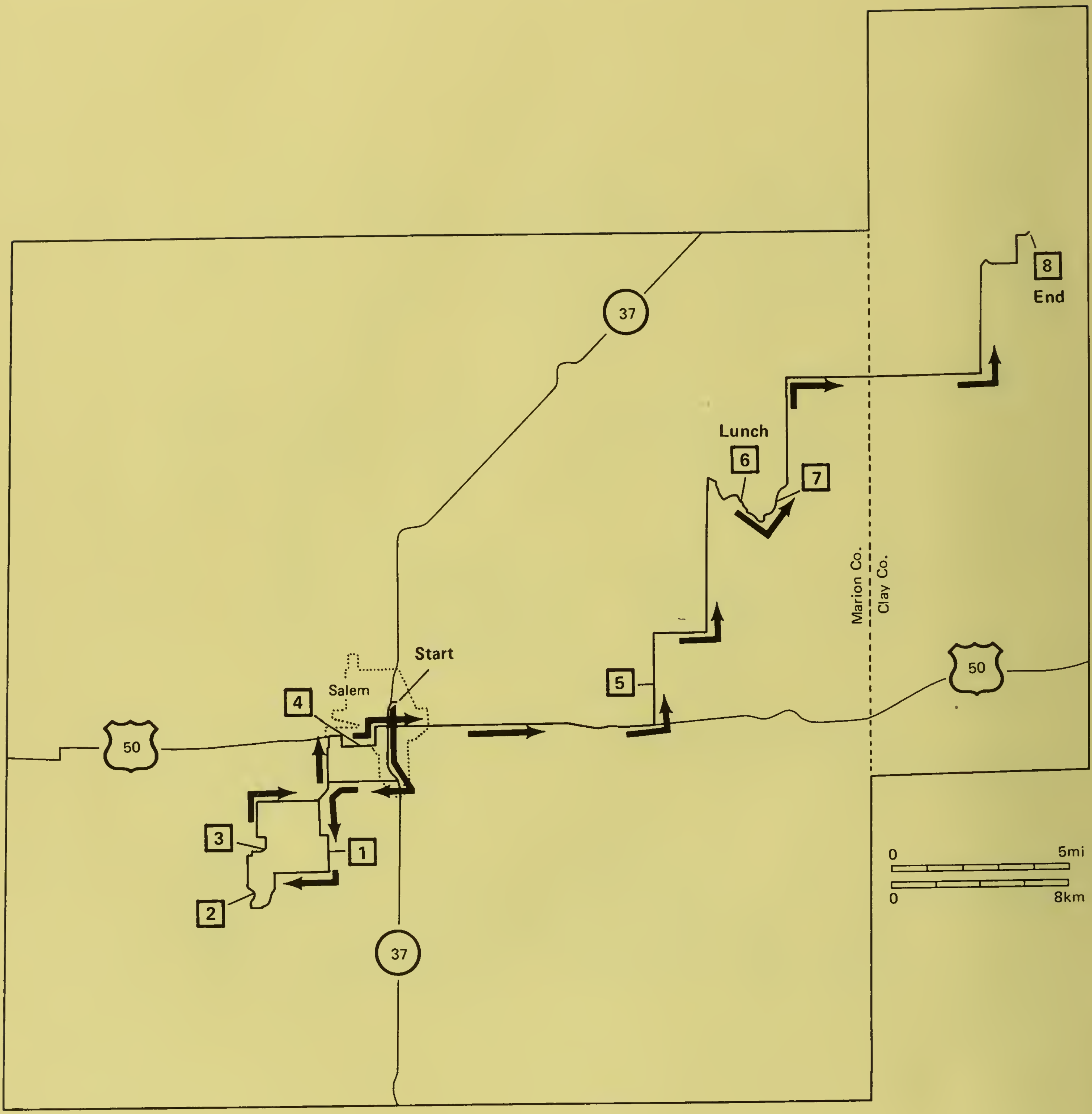
*Trepospira sphaerulata* 1x

*Knightites montfortianus* 2x

*Glabrocingulum (Glabrocingulum) grayvillense* 3x

BRACHIOPODS




37
Lunch
6
7
8
End
Marion Co.
Clay Co.
Start
Salem
4
5
50
50
3
1
2
37
0
5mi
0
8km